

50 CLAIMS:

1 1. A method for installing a heat exchange pipe loop in a
2 borehole, the method comprising

3 drilling a borehole from an earth surface down into
4 earth using sonic apparatus with a sonic drill head, the sonic
5 drill head having casing connected thereto, drill apparatus
6 connected to a lower end of the casing so that movement of the
7 casing by the sonic drill head drills the borehole down into
8 the earth, the casing having an interior,

9 pumping drilling fluid down into the casing during
10 drilling, down through the casing and out through the drilling
11 apparatus, and upwardly in an annular space between an
12 interior surface of the borehole and an exterior surface of
13 the casing so that drilled material flows upward through the
14 annular space in the borehole preventing drilled material from
15 flowing up into the casing's interior,

16 lowering a heat exchange pipe loop down into the
17 casing,

18 introducing grout into the casing around the heat
19 exchange pipe loop, the grout displacing an amount of the
20 mixture of drilling fluid from within the casing, and

21 extracting the casing from the borehole.

1 2. The method of claim 1 further comprising

2 introducing grout into the casing as the casing is
3 extracted from the borehole.

1 3. The method of claim 1 further comprising

2 introducing grout into the borehole around the heat
3 exchange pipe loop after the casing has been extracted from
4 the borehole.

1 4. The method of claim 1 further comprising

2 oscillating the casing with the sonic apparatus as
3 the casing is extracted from the borehole.

1 5. The method of claim 4 wherein the oscillating of the

2 casing accomplishes at least one function from the group consisting
3 of: facilitation of casing extraction; inhibiting grout bridging;
4 de-aerating the grout; increasing density of the grout; oscillation
5 of drilled material; and reduction of friction between the casing
6 and the grout.

1 6. The method of claim 1 further comprising
2 oscillating the casing as grout is introduced into
3 the casing.

1 7. The method of claim 1 further comprising
2 adding drilling fluid additive to the drilling fluid
3 during drilling.

1 8. The method of claim 1 wherein the borehole is at least
2 300 feet deep; the borehole is drilled, the heat exchange pipe loop
3 is lowered, the grout is introduced, and the casing is extracted
4 within one hour.

1 9. The method of claim 1 further comprising
2 introducing water into the heat exchange pipe loop
3 to inhibit collapse of the heat exchange pipe loop.

1 10. The method of claim 9 wherein the heat exchange pipe loop
2 is substantially filled with water and is sealed following filling
3 with water.

1 11. The method of claim 9 wherein the water is pumped at a
2 pressure of about 100 p.s.i.

1 12. The method of claim 1 wherein the grout is introduced
2 into the casing by pumping the grout into the casing.

1 13. The method of claim 1 wherein the grout is introduced
2 into the casing by pouring the grout into the casing.

1 14. The method of claim 1 wherein the grout includes set
2 retardant material.

1 15. The method of claim 1 wherein the heat exchange pipe loop
2 is made from material from the group consisting of polyethylene,
3 steel, aluminum, aluminum alloy, zinc, zinc alloy, composite and
4 fiberglass.

1 16. The method of claim 1 wherein the sonic apparatus is on
2 and is movable by a truck or crawler apparatus, the method further
3 comprising

4 moving the sonic apparatus adjacent a location of
5 the borehole.

1 17. The method of claim 1 further comprising

2 pumping a volume of drilling fluid into the casing
3 that is greater than a volume of drilled material.

1 18. The method of claim 1 wherein the casing comprises a
2 string of interconnected pieces of casing and pieces of casing as
3 needed are added to the string as drilling progresses.

1 19. The method of claim 1 wherein the drill apparatus is a
2 bit or drillshoe with an outer diameter within 110% of an outer
3 diameter of the casing.

1 20. The method of claim 1 wherein the drilling produces
2 drilled material and substantially all of the drilled material does
3 not exit from the borehole at the earth surface.

1 21. The method of claim 1 further comprising

2 removing the drill apparatus from the lower end of
3 the casing,

4 inserting a secondary drilling apparatus through the
5 casing, and

6 drilling an extension of the borehole with the
7 secondary drilling apparatus.

1 22. The method of claim 21 wherein the secondary drilling
2 apparatus is from the group consisting of: a coil tubing drilling
3 system; a compressed air drilling system; and a downhole motor
4 drilling system.

5 23. A method for compacting grout in a borehole, the method
6 comprising oscillating a tubular apparatus in the grout.

1 22. The method of claim 23 wherein the tubular apparatus is
2 a string of casing.
3